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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Differential Fertility in Guyana," submitted by Paul Kuzel in partial fulfilment of the requirements for the degree of Master of Arts.

ABSTRACT

This study explores the phenomenon of differential fertility in Guyana. The 1960 census data have been used for the analysis.

Since birth registration data are not available by ethnic origin, the computation of direct fertility measures was rendered impossible. But it was possible to derive estimates of direct measures from indirect ones such as the child-woman ratio which can be obtained from census data. Two methods have been employed for estimating direct measures from indirect ones for Guyana. Using the Bogue-Palmore procedure, estimates of the crude birth rate, the age-specific fertility rates, and the general fertility rate were obtained. Application of the technique developed by Rele yielded estimates of the gross reproduction rate and the crude birth rate.

The results obtained by these two methods show that the "Mixed" group has the highest fertility in Guyana followed by the East Indians, the Amerindian, the Negro, the Chinese and the Portuguese, in that order.

Three hypotheses derived from earlier studies have been used to explain the differences in fertility between the East Indians and the Negro:

1. If a female population in a group is characterized by a larger incidence of unstable unions, that group will have lower fertility than one which is not so characterized.

2. If the proportion of single women in reproductive ages in

a population segment is larger, then that segment will have lower fertility.

3. If a population group has a higher proportion of females with a certain level of education, then that population group will experience lower fertility than one with a lower level of education.

Multiple regression analysis with child-woman ratio as the dependent variable confirms two of the hypotheses.

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CHAPTER I

INTRODUCTION

> There is no event in personal history more significant for the future than becoming a parent and there is no pattern of behavior more essential for societal survival than adequate fertility. . . . The individual and social importance of proper knowledge of this vital activity cannot be overstated. . . . changes in procreative behavior are influential accompaniments of virtually every variation in the fortunes of society (Ryder, 1959: 400).

Concern with rapid growth of world population during the second half of the current century has encouraged and focused attention on studies of human fertility and reproduction. There are biological constraints on human reproduction, but fertility mostly results from decisions made by people, as they are influenced by group norms and social institutions. Most social demographers, however, maintain that all of the large differences that have been identified are cultural and social, not biological in origin.

Demographers have paid increasing attention in recent years to differential fertility within populations according to class, education, racial groups, and other kinds of differentiation. This type of procedure permits a more detailed analysis of the level of changes in fertility. There are a few reasons for it:

1. The size of homogenous groups is relatively small in comparison with the whole nation. Consequently, we are able to isolate the determinants of reproductive behavior more easily.

2. The knowledge of more precise fertility differentials may serve as a basis for estimating more accurately the future trends of fertility in the whole population.

3. From the fertility differences between groups, we can determine the proportions of the total population which these groups will constitute in the future (Thomlinson, 1965: 173).

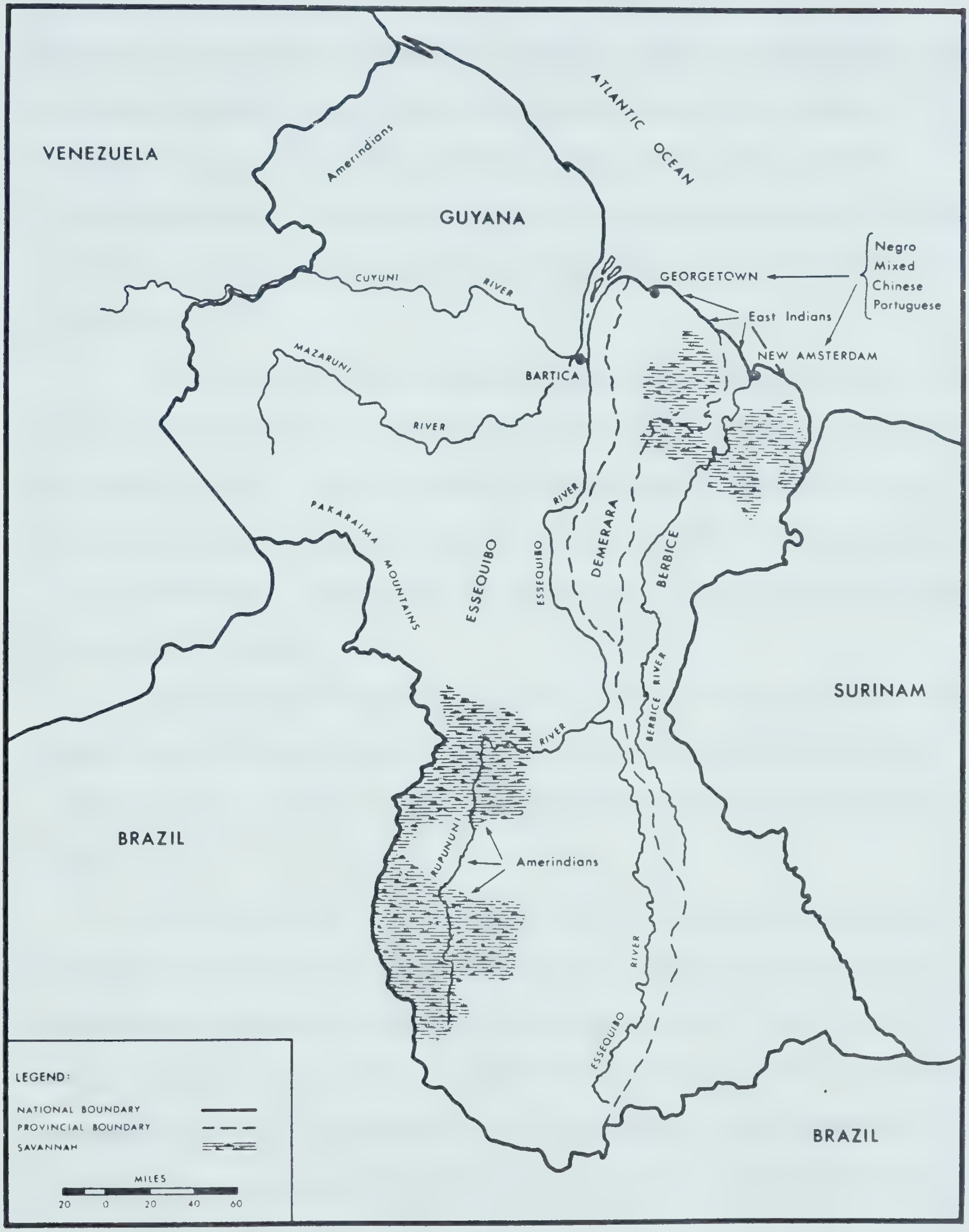
Guyana is a nation in South America about whose population very little is known. The research attempted here will concern itself with the population of Guyana.

Guyana is an old Amerindian word that means "Lands of the Waters." There could hardly be any better name for this area since it has a heavy rainfall and many large rivers--the Essequibo, the Demerara, and the Berbice, to name a few.

Guyana is located in the northeast corner of South America. It shares borders with Surinam on the east, Venezuela on the west, and Brazil on the south (see Figure 1). Guyana, with an area of 83,000 square miles, is a country about the same size as Great Britain. However, its population according to the United Nations' estimates for 1971 was 720,000.

Geographically, we can distinguish three parts of the country: a coastal zone, a forest area, and a savannah region. Only the coastal strip has so far been of major social and economic importance. The coastal zone is some 270 miles long and at most 20 to 30 miles wide. Approximately 90 per cent of the total population lives there, crowded on a small area of only a thousand square miles. As may be expected, the interior is virtually uninhabited. For the whole country,

FIGURE 1. MAP OF GUYANA



the population density is between six and seven per square mile. Permanent cultivation of the coast lands is based on monoculture. The principal economic crops include sugar cane, rice, and coconuts. Production of sugar and its by-products comprises the most important economic activity. The coastal area is not only significant from this point of view but also from the fact that all productive industries are found here.

Almost 70,000 square miles of the country, that is, over 80 per cent of the total area, is covered by forest. This area extends beyond the coastal area. The forest area is economically important for the country. Mineral deposits--bauxite, gold, diamonds, and manganese--are to be found there. Also, the lumber industry is an important resource for Guyana's economy.

The savannahs extend over an area of 6,000 square miles. This small area in the southwestern part of the country is suitable for cattle grazing. However, the remoteness of the district makes marketing a problem.

Seventy-one per cent of the population in 1960 consisted of residents in villages on the coastal plain. The two largest cities, metropolitan Georgetown and New Amsterdam, contained less than one-third of the population in 1960. In comparison with other South American countries, Guyana is relatively little urbanized. For example, Chile in 1964 had an urban population of 68.2 per cent and Uruguay 82.2 per cent (Bogue, 1969: 469).

The country enjoys a very high precipitation, with an average of over 80 inches of rainfall annually. The temperature is uniformly

high on the coast, never falling below 60 degrees Fahrenheit nor rising above 90 degrees Fahrenheit. This climatic stability is primarily due to the influence of the strong Northeast Trade Winds. The climate in the hinterland is not so uniform as it is on the coast. Rainfall is sometimes as low as 40 to 50 inches annually, with temperatures on mountain ranges falling as low as 25 degrees Fahrenheit (Poonar, 1966: 166).

The original population, Amerindian, does not form a significant social group in Guyana (about 4.5 per cent). They live mainly in the interior, where they engage in agriculture and hunting. They are split into several different tribes, each of which speaks its own dialect. In the early days of colonization, the Indians suffered from slave raids and from European diseases.

The rest of the present population has been built up from immigrants. It is one of the most important distinctions, when compared with other South American countries, that migration was the dominant factor in population growth during one century, from 1830 to 1917 (Roberts, 1960). Two types of migration developed as a direct response to the shortage of plantation labor after slavery was abolished in Guyana in 1834. The most important one, from the political and the demographic points of view, was indentured immigration which had already commenced before 1834 when it became apparent that the period of slave labor was over. This type of migration continued up to 1917. Migrants came from India, the West Indian islands, Britain, Germany, Portugal, and other European countries, and from China. The most important immigrant group was, however, that of the East Indians. Between 1846 and 1917,

about 239,000 came to Guyana (Roberts, 1960).

The second type of migration that occurred during the same period of time was the shift of population from the older and more densely settled Caribbean islands to the newer and more sparsely settled colonies.

Guyana's multi-racial and multi-ethnic society has emerged as a result of these two types of migration and the subsequent intermingling of races. According to the 1960 census, the population can be classified into several ethnic groups (see Table 1). In comparison with other South American countries, we would find that Europeans or their descendants form a much larger proportion of the total population. In many other South American countries (e.g., Peru, Bolivia), the proportion of native peoples is considerably high. While East Indians form the largest group in Guyana, their number in other South American countries is negligible.

During the first two decades of the twentieth century, there was a marked decline in indentured immigration and considerable outflow from the region as a result of a depression in the sugar industry. Increased emigration combined with high death rates produced a notable decline in the growth of the population. According to available data, the population of Guyana was 289,140 people in 1911 and 288,541 in 1921, showing a decline of 0.2 per cent.

Before 1917, immigrants arriving in Guyana had a very unbalanced sex composition. For example, among the East Indians there were 40 females per 100 males (Smith, 1962: 8). This situation, combined with high mortality resulted in a low natural increase in the population.

TABLE 1

ETHNIC GROUPS IN GUYANA

ETHNIC GROUP	NUMBER	PER CENT
Negro	183,950	33.0
White	3,217	0.6
East Indian	267,807	48.0
Chinese	4,074	0.7
Mixed	67,191	12.0
Amerindian	25,493	4.0
Lebanese, Syrian	69	0.01
Portuguese	8,172	1.0

Source: British Guiana, Population Census 1960, Vol. II, Part A.

It was only after the First World War that important changes took place. Declining mortality and increasing fertility produced a high rate of population growth. The years following 1920 witnessed a continuous decline in death rates. Mandle (1970) studied the mortality situation in Guyana for the period 1911-1960. His conclusion, one which is typical for any developing country, was that the decline was caused not by economic advances but improvements in general health conditions. Mandle estimates that about 40 per cent of the post-Second World War decline was a consequence of the DDT program. Thus the gradual decline in the death rate, which took a sharp gradient in the post-war period, eventually resulted in a high rate of population growth ranging between three and four per cent. The Guyanese population had increased to 560,330 at the time of the 1960 census, almost doubling since 1921. In 1920-1922, the average life expectancy of men was 33.5 years and for women, 35.8 years; by 1950-1952, it had risen to 53.2 and 56.3 years and by 1960 to 59.0 and 63.0, respectively (United Nations Demographic Yearbook 1970).

Of course, a decline in the death rate could not account, by itself, for the rapid population growth. There was also an upsurge in the birth rate. While the average death rate in the period 1931-1935 was 22.5 per 1,000, in the period 1957-1961, it was 10.0, almost half as large as it was thirty years ago. However, during the same period, we find that the crude birth rates were 32.2 and 43.5 per 1,000, respectively (Newman, 1964: 35). Needless to say, these two processes, occurring in the opposite direction, have been responsible for a major upsurge in the rate of natural increase. In 1931-1935, the rate of

natural increase was 9.7 while in 1957-1961 it was 33.5, three times larger than the rate which prevailed thirty years ago (Newman, 1964: 35).

Extensive studies on different fertilities have been carried out in the United States. The best known of these is the Whelpton-Kiser Indianapolis study (1941). The authors attempted to explore social-psychological factors affecting fertility differences. Though their findings concerning the interrelations between family size, contraceptive usage, and socio-economic status were significant, the search for attitudinal correlates of family planning yielded rather disappointing results. The Princeton studies (Westoff, et al., 1961, 1963; Bumpass, et al., 1970) contributed to our knowledge of social variations in contraceptive knowledge, in contraceptive practice, of fertility expectations, and of actual fertility.

The "Growth of American Family" studies were designed to obtain data on contraception and fertility expectations which could be analyzed to provide explanations of fertility differences in terms of social variables. One such study (Freedman, et al., 1959) showed the important fact that families in the United States typically limit the number of children they have to two to four and that differentials in fertility by socio-economic status and urban-rural residence are narrowing.

Studies done by Bogue (1969) reveal that in the United States there is a strong inverse correlation between the educational level attained and the level of fertility. The highest levels of fertility are found among women with no schooling; women with college educations had the lowest fertility.

A number of studies and surveys on differential fertility were carried out for Latin American countries. Perhaps one of the most comprehensive studies of differential fertility for this part of the world was done by the Population Branch of the United Nations' Secretariat in 1958. The findings of this study, based on child-woman ratios, show that fertility is uniformly low for urban women.

A comparative analysis of fertility for several Latin American cities done by Miro and Rath (1965) reveal that fertility in these cities differed according to age, marital status, place of birth, educational level, religion, and occupational status of the women interviewed.

Stycos (1963) found that in Peru fertility was highest in the Spanish rural areas and lowest in the Indian urban areas. He advanced the hypothesis that these differences may be due to differential mating patterns on the part of Indians and Mestizos. He suggested, moreover, that due to more permissive norms concerning sexual relations, Indians establish cohabiting relations later than do Mestizos and that such unions are less stable than Mestizo ones, even though common-law relations are more characteristic in Spanish-speaking areas.

According to Neiva (1966), in Brazil the average size of a completed family for the "mixed" group was 6.3, the highest among all ethnic groups (see Table 2 for a similar result on Guyana). The white fertility was second with a size of 6.0 followed by the Negro group with a size of 5.6.

Studies by Blake (1961) and Stycos (1968) also reveal that there exist fertility differentials in the South American, or the

TABLE 2

CHILD-WOMAN RATIOS FOR SELECTED
ETHNIC GROUPS IN GUYANA*

Guyana	East Indian	Negro	Mixed	Chinese	Amerindian	Portugese
816	906	666	1012	378	841	411

$$\frac{C(0-4)}{W(15-49)} \cdot k$$

$k = 1000$

Source: Calculated from 1960 Census for British Guyana.

Caribbean region. In view of the unique history behind the growth of population in Guyana, it is clear that the different ethnic groups may exhibit differences in reproductive behavior.

The plan of the thesis is as follows: Chapter II is devoted to a discussion of the demographic methodology employed in the estimation of the characteristics of the different ethnic groups comprising the Guyanese population. Estimates are presented in Chapter III. The phenomenon of differential fertility in Guyana is discussed in Chapter IV. A summary of findings and problems of future research are given in the last chapter.

CHAPTER II

METHODOLOGY

Methodology is the most important part of an empirical study, and in the analysis of vital events such as fertility and mortality there are two major aspects to an inquiry. In the case of fertility, we can study:

1. fertility trends over time, and/or
2. differential fertility between groups of a population.

The latter inquiry is, of course, the core of the thesis.

2.1 Availability of Data

Demographic statistics are relatively the best in the social science disciplines, though far from perfect. By and large, the quality of population statistics has improved over time and, for any period, is best for the developed nations. It is generally accepted that demographic statistics for most developing countries are insufficient or non-existent. As we move from mere counts of total population to more detailed statistics such as distribution, composition of a population, the scarcity of demographic statistics increases rapidly. The amount of characteristics of a population gathered varies from region to region, and well as from time to time.

Though Guyana is certainly a developing country, it has relatively reliable registration and census data. Despite this positive factor, we cannot find in the 1960 census the necessary information

concerning the various ethnic groups for the development of estimates of birth rates for those segments of the Guyanese population. The problem here is that the data on registration of births are not published separately for the various groups. The reasons for this non-availability of published statistics may be political, religious, or administrative.

2.2 Methods of Estimation of Direct Fertility Measures from Indirect Ones

A number of different fertility measures depending on data availability have been developed, each of which has its own advantages and disadvantages in describing fertility. These measures can be classified into two basic groups: direct measures of fertility (such as crude birth rate, general fertility rate, or age-specific fertility rate) and indirect measures of fertility (such as various types of child-woman ratio). The first group of measurements is derived from vital statistics and census data. The indirect measures are derived from census data only. Until now, the indirect measures of fertility have been used more extensively in demographic research pertaining to developing nations. For almost two-thirds of the world's population, the registration of birth is incomplete or non-existent to the extent that it is essentially unsuitable for any worthwhile demographic research. The indirect measures conceal, however, factors other than fertility and as such are less precise than direct measures.

The CHILD-WOMAN RATIO is designed to furnish a measurement of fertility where birth statistics are incomplete or not available and the handy data are the distribution of population by age and sex at the time of a census. The child-woman ratio is defined as follows:

$$\text{child-woman ratio} = \frac{\text{number of children under age 5 according to the census}}{\text{female population in the age group 15-44 according to the census}}$$

However, the ratio is based upon the survivors of births during the five years preceding the census. It thus unavoidably includes the effects of infant and childhood mortality during this period and, therefore, tends to underestimate fertility. As a consequence, the absolute values of this ratio have less relevant significance. The utility of the ratio lies in its ability to serve as a relative measure of fertility, for comparing different sections of the same population (Barclay, 1958: 172).

Because of the non-availability of data for the various ethnic groups in Guyana, we are unable to compute direct fertility measures for these groups. However, because of the availability of census data by age, we can estimate direct measures from such indirect ones as the child-woman ratio. Two methods for this type of exercise will be explained in the following paragraphs.

2.3 Bogue-Palmore Method

With the help of regression analysis, Bogue and Palmore (1964) have developed important mathematical relationships between direct and indirect measures of fertility. Their work essentially involved three major steps: firstly, they tried to establish empirical interrelationships between each direct measure of fertility; then they applied this same procedure to indirect measures; thirdly, they tried to establish relations between direct and indirect fertility measures.

In order to develop their mathematical relationships, Bogue and Palmore selected 50 nations whose data, covering the period 1955-1960, provided reliable information on the following:

1. births by age of mother;
2. population by age and sex;
3. marital status; and
4. deaths of infants during the first year of life

(Bogue and Palmore, 1964: 318). These data enabled them to compute all direct and indirect fertility measures.

Bogue and Palmore correlated the direct and the indirect measures. They obtained a set of high correlations between direct and indirect measures of fertility. The parameters of the regression equations are shown in Table 3. This result is of considerable significance since it makes possible the estimation of basic fertility measures from indirect ones within a narrow margin of error.

2.4 Rele's Method

It has been shown elsewhere that age and sex are the basic characteristics in demographic analysis. In fact, all other population characteristics are contingent in one way or another on age and sex distributions (Hawley, 1959: 370). These two characteristics are important not only from the social and economic point of view but also because of their independent variability. These two basic characteristics of individuals are in no way determined by such things as education, marital status, or other similar demographic traits. Furthermore, age and sex composition of a population can be known in

TABLE 3

SLOPES AND INTERCEPTS OF THE REGRESSION LINES BETWEEN THE DIRECT AND INDIRECT FERTILITY MEASURES: 50 NATIONS FOR WHICH RELIABLE STATISTICS WERE AVAILABLE FOR THE PERIOD 1955 TO 1960

Direct Fertility Measures	Ratio of C/W, 0-4	Ratio of C/W, 0-4	% of Pop. 0-4	% of Pop. 5-9	% of Pop. 0-14
	Slopes of the regression lines with indirect fertility measures				
Crude Birth Rate	0.0529	0.0664	2.6263	3.2723	1.1835
General Fertility Rate	0.2532	0.3174	12.346	15.262	5.5479
General Fertility Rate--dir. std.	0.2351	0.2938	11.384	13.978	5.0992
General Fertility Rate--ind. std.	0.2381	0.2976	11.534	14.171	5.1736
Total Fertility Rate	7.6988	9.6595	372.76	459.82	167.48
Age-specific Fertility Rate, 15-19	0.1821	0.2184	9.0649	10.760	3.9492
Age-specific Fertility Rate, 20-24	0.3470	0.4231	16.623	19.789	7.3044
Age-specific Fertility Rate, 25-29	0.3423	0.4314	16.361	20.220	7.4049
Age-specific Fertility Rate, 30-34	0.2989	0.3826	14.409	18.127	6.5373
Age-specific Fertility Rate, 35-39	0.2480	0.3173	12.098	15.265	5.5137
Age-specific Fertility Rate, 40-44	0.0993	0.1304	4.8616	6.3305	2.2556
Age-specific Fertility Rate, 45-49	0.0221	0.0287	1.1347	1.4727	0.5318
	Intercepts of the regression lines with indirect fertility measures				
Crude Birth Rate	0.1373	-3.8590	-4.2551	-8.6670	-11.724
General Fertility Rate	-13.231	-32.036	-31.517	-50.910	-66.094
General Fertility Rate--dir. std.	-1.3641	-18.386	-17.375	-34.212	-48.712
General Fertility Rate--ind. std.	-3.8704	-21.169	-20.154	-37.312	-52.147
Total Fertility Rate	-83.562	-660.14	-607.95	-1182.9	-1651.3
Age-specific Fertility Rate, 15-19	-31.617	-40.535	-47.048	-56.355	-68.315
Age-specific Fertility Rate, 20-24	20.056	8.8870	7.5849	-10.122	-33.486
Age-specific Fertility Rate, 25-29	40.791	14.249	20.060	-5.5842	-27.514
Age-specific Fertility Rate, 30-34	0.0176	-25.960	-19.591	-45.723	-62.020
Age-specific Fertility Rate, 35-39	-34.143	-55.591	-52.099	-74.545	-88.554
Age-specific Fertility Rate, 40-44	-15.129	-25.306	-22.525	-33.716	-38.497
Age-specific Fertility Rate, 45-49	-5.7103	-7.7955	-7.9921	-10.550	-11.896

Source: Bogue, B. J. and Palmore, J. A. "Some Empirical and Analytical Relations among Demographic Fertility Measures, with Regression Models for Fertility Estimation." Demography, Volume 1, Number 1, 1964, Table 8, p. 325.

advance under certain conditions: that is, when the age schedules of mortality and fertility are given and no migration assumed, a definite age and sex composition will emerge.

The emergence of an age composition may be shown by the stable population concept or its derivative quasi-stable theory. It assumes that a population is characterized by constant age-specific schedules of fertility and mortality and is closed to migration. If these conditions prevail in a population for a long period of time, such a population will experience a fixed rate of natural increase and unchanging (stable) age and sex composition.

In Rele's monograph (1967), the stable population theory was tested and through its application Rele was able to estimate three basic fertility measures: the gross reproduction rate, the intrinsic birth rate, and the crude birth rate. He based his study on the theoretical relationships of the age distribution of population with measures of fertility and mortality where no migration is involved. This method, like the Bogue-Palmore one, enables us to estimate birth rate, or allied measures of fertility, for countries with inadequate data.

The important fact is that the age distribution can be obtained from the census. As stated earlier, the present age distribution can be seen as a result of past trends in the components of population growth, namely birth and death rates. This is the central idea of Rele's method. The age distribution is not seriously affected by changing mortality, the reason being that when mortality changes from one level to another, the change tends to affect all ages (though the

magnitude of this change varies from one age to another). On the other hand, fertility change affects only the age zero (Ryder, 1959: 408). When fertility has been constant over a long period of time, an approximate idea of a population's mortality level is sufficient for us to make fairly accurate estimates of its fertility, based on the age distribution. This is feasible because the relationships between the birth rate, the mortality rate, and the age distribution are at all times the same as in a stable population where the present conditions of fertility and mortality have already prevailed over an indefinite period of time (United Nations, 1967). To ascertain the validity of the model through comparison of estimated values with those from the registration data, the model was initially applied by Rele to European countries with good demographic data, yielding fruitful results. The method was then applied to the estimation of the fertility rates of Latin American countries.

2.5 Assumptions Underlying the Rele Approach

Rele (1967) makes the important assumption that the relative age-specific fertility schedules for women in different reproductive age groups show a certain constant pattern. This pattern is independent of general fertility levels. The justification for this assumption was provided by the actual findings on the age-specific fertility rates for 52 countries. Though they differed considerably in their levels of fertility, the age-specific fertility rates for the six five-year age groups 15-19, 20-24, . . ., 45-49 showed a consistent relationship. This enabled Rele to express the whole set of age-specific fertility

and mortality rates by one index of fertility and mortality. Rele employed gross reproduction rate and e_o^o as a measure of fertility and mortality, respectively.

However, one more important assumption is considered in the model. As mentioned earlier, the variations in the age distributions are little affected by mortality. Thus, it would be possible to ascribe one age distribution to a rather wide range of different mortality levels. As a consequence, the precision of estimation would be in doubt. Is it possible to remove this shortcoming of the model?

The utility follows from the fact that from any two non-redundant characteristics of a population, all others can be estimated. Rele showed that each of them can be expressed as a function of gross reproduction rate and e_o^o in the following way:

$$C_1 = f(GRR,\ e_o^o)$$

$$C_2 = g(GRR,\ e_o^o)$$

where C_1 and C_2 are two non-redundant characteristics.

In effect, the values of gross reproduction rate and e_o^o can be obtained from functions of C_1 and C_2. In the United Nations' Study No. 28 (1958) it has been shown that only one solution exists for most characteristics of stable population. Where the above assumptions are imposed, it then implies that gross reproduction rate and e_o^o are unambiguously determined. Thus, on the basis of any two population characteristics, it is theoretically possible to determine the remaining ones by finding the corresponding stable age distribution.

A set of 36 stable age distributions was compiled describing six different levels of fertility by the gross reproduction rate, and six different mortality levels given by the expectation of life at birth (e_o^o) in years. In the model the following values of gross reproduction rate were considered: 4.0, 3.0, 2.5, 2.0, 1.5, and 1.0; 20, 30, 40, 50, 60, and 70 years for e_o^o. As previously mentioned, due to small variations between the age-specific fertility rates for various populations, the standard ratio 1:7:7:6:4:1 for the six five-year reproductive age groups (15-44) was assumed for each gross reproduction rate. The weights in this case are not strictly proportional. Rele ascribed lower weights to the extreme age groups 15-19 and 40-44 because of their higher variability of the rates in these age groups. Some difference in this respect would clearly appear between countries with high and low fertility. The evidence, however, showed that these differences were not substantial.

The choice of child-woman ratio and expectation of life at birth as two population characteristics, each representing different categories, was based on the following facts: a measure (such as child-woman ratio) derived from the age distribution is easier to calculate than any other when we face inadequate registration. In fact, four types of child-woman ratios were used by Rele:

$$\frac{C(0\text{-}4)}{W(15\text{-}44)} \qquad \frac{C(0\text{-}4)}{W(15\text{-}49)} \qquad \frac{C(5\text{-}9)}{W(20\text{-}49)} \qquad \frac{C(5\text{-}9)}{W(20\text{-}54)}$$

(C stands for children and W for women, with the age group in parentheses).

To eliminate errors of the census regarding under-enumeration of children below age 5, the last two ratios were included. Though the age group (5-9) suffers less from this defect, it is affected by mortality for a longer period of time.

The choice of e_o^o has practical implications. The advantage here is that the value of e_o^o can only be roughly guessed. Even if this value is guessed wrongly, it will have a relatively minor effect on the fertility index. Rele has shown that a guessed value of e_o^o to the nearest multiple of ten will be sufficient for the estimation of fertility.

2.6 Estimation of Gross Reproduction Rate

Gross reproduction rate may be given by the formula

$GRR = 5 \sum_{i=1}^{6} \frac{(b_i^f)}{P_i} K$, where b_i^f is the number of live female births, registered during the year, to mothers of age (i); P_i is the mid-year population of women of the same age; K is equal to 1,000 (Barclay, 1968). In other words, it is the sum of age-specific fertility rates of females 15-44 or 15-49, counting only female births. It is a summary index of fertility customarily used in fertility analysis and gives us the expected number of "daughters per woman" assuming no force of mortality.

The procedure, which is based on Rele's method, essentially involves the usual method of establishing relationships between the dependent variable (in our case, gross reproduction rate) and independent variables (in our case, child-woman ratio and e_o^o). The constants presented by Rele (1967) (see Table 4) were employed to estimate the gross

TABLE 4

COEFFICIENTS FOR THE ESTIMATION OF GROSS REPRODUCTION RATE FROM CHILD-WOMAN RATIO

Type of Child-Woman Ratio	Regression Coefficient*	e_o^o					
		20	30	40	50	60	70
$\frac{C(0-4)}{W(15-44)}$	a	-0.0909	-0.1211	-0.1370	-0.1529	-0.1645	-0.1754
	b	4.5907	4.1821	3.9298	3.7375	3.5556	3.3878
$\frac{C(0-4)}{W(15-49)}$	a	0.0547	0.0284	0.0129	-0.0059	-0.0182	-0.0309
	b	4.7680	4.3293	4.0617	3.8589	3.6628	3.4829
$\frac{C(5-9)}{W(20-49)}$	a	-0.1162	-0.1311	-0.1436	-0.1574	-0.1675	-0.1779
	b	5.2927	4.4881	4.0940	3.8301	3.5967	3.3894
$\frac{C(5-9)}{W(20-54)}$	a	0.0245	0.0106	0.0021	-0.0110	-0.0226	-0.0345
	b	5.4711	4.6398	4.2262	3.9480	3.7014	3.4821

* Coefficients of the regression equations $Y = a + bX$ for each e_o derived from stable populations, where Y is the gross reproduction rate and X is the child-woman ratio.

Source: J. R. Rele. <u>Fertility Analysis Through Extension of Stable Population Concepts</u>, 1967: Table 4, p. 22.

reproduction rate from the regression equation $y=a+bX$, where y is the gross reproduction rate, X the child-woman ratio, and a and b are the Rele constants.

2.7 Estimation of Intrinsic Birth Rate

Estimation of crude birth rate is to be carried out in two stages. The first one involves the estimation of the intrinsic birth rate on the basis of which the crude birth rate will be derived.

The estimation of the intrinsic birth rate will be the estimation of the birth rate which refers to the corresponding stable age distribution. Thus "the intrinsic birth rate of any population is its expected birth rate when the age distribution of the population coincides with that of a stable population with the same age-specific fertility and mortality rates" (Rele, 1967: 52). Consequently, the intrinsic birth rate is only one for the given level of fertility and mortality, because it is related to a fixed age distribution. In turn, the crude birth rate may change with the actual age distribution of the population (Rele, 1967: 52).

Rele examined the relationship between intrinsic birth rate and child-woman ratio under different levels of mortality. The relationship between birth rates and child-woman ratios on the one hand and gross reproduction rate and child-woman ratio are clear from the Tables 5 and 6, and Figure 2. In comparison with relationship between child-woman ratio and gross reproduction rate, we can notice that the former does not show linear relationship. Therefore, instead of fitting a straight line, the second degree equation $y=a+bX+cX^2$ was used, where

TABLE 5
BIRTH RATES ESTIMATED FROM CHILD-WOMAN RATIOS COMPARED TO THE ACTUAL BIRTH RATES FOR STABLE POPULATIONS DESIGNATED BY THE GROSS REPRODUCTION RATE AND EXPECTATION OF LIFE AT BIRTH*

e_o^o	GRR	Estimated Birth Rates Using $\frac{C(0-4)}{W(15-49)}$	Estimated Birth Rates Using $\frac{C(5-9)}{W(20-54)}$	Actual Birth Rate
20	4.0	63.8	63.8	63.8
20	3.0	50.5	50.5	50.5
20	2.5	42.8	42.8	42.8
20	2.0	34.2	34.3	34.2
20	1.5	24.8	24.8	24.8
20	1.0	14.6	14.6	14.6
30	4.0	59.8	59.8	59.8
30	3.0	47.8	47.8	47.7
30	2.5	40.7	40.7	40.6
30	2.0	32.5	32.5	32.7
30	1.5	23.8	23.8	23.8
30	1.0	14.1	14.0	14.0
40	4.0	57.3	57.3	57.3
40	3.0	46.0	46.0	46.0
40	2.5	39.3	39.3	39.3
40	2.0	31.7	31.7	31.7
40	1.5	23.1	23.1	23.1
40	1.0	13.6	13.6	13.6
50	4.0	55.7	55.7	55.7
50	3.0	45.0	45.0	44.9
50	2.5	38.4	38.4	38.4
50	2.0	31.0	31.0	31.1
50	1.5	22.7	22.7	22.7
50	1.0	13.4	13.4	13.4
60	4.0	54.1	54.1	54.1
60	3.0	43.9	43.9	43.8
60	2.5	37.7	27.7	37.7
60	2.0	30.6	30.6	30.6
60	1.5	22.4	22.4	22.5
60	1.0	13.4	13.4	13.3
70	4.0	52.7	52.7	52.7
70	3.0	43.0	43.0	42.9
70	2.5	37.0	37.0	37.0
70	2.0	30.0	30.0	30.1
70	1.5	22.2	22.2	22.3
70	1.0	13.4	13.4	13.3

* Estimated birth rates using the coefficents for the curvilinear relationships given in Table 7.

Source: R. J. Rele, Fertility Analysis through Extension of Stable Population Concepts, 1967 : Table 14, p. 55.

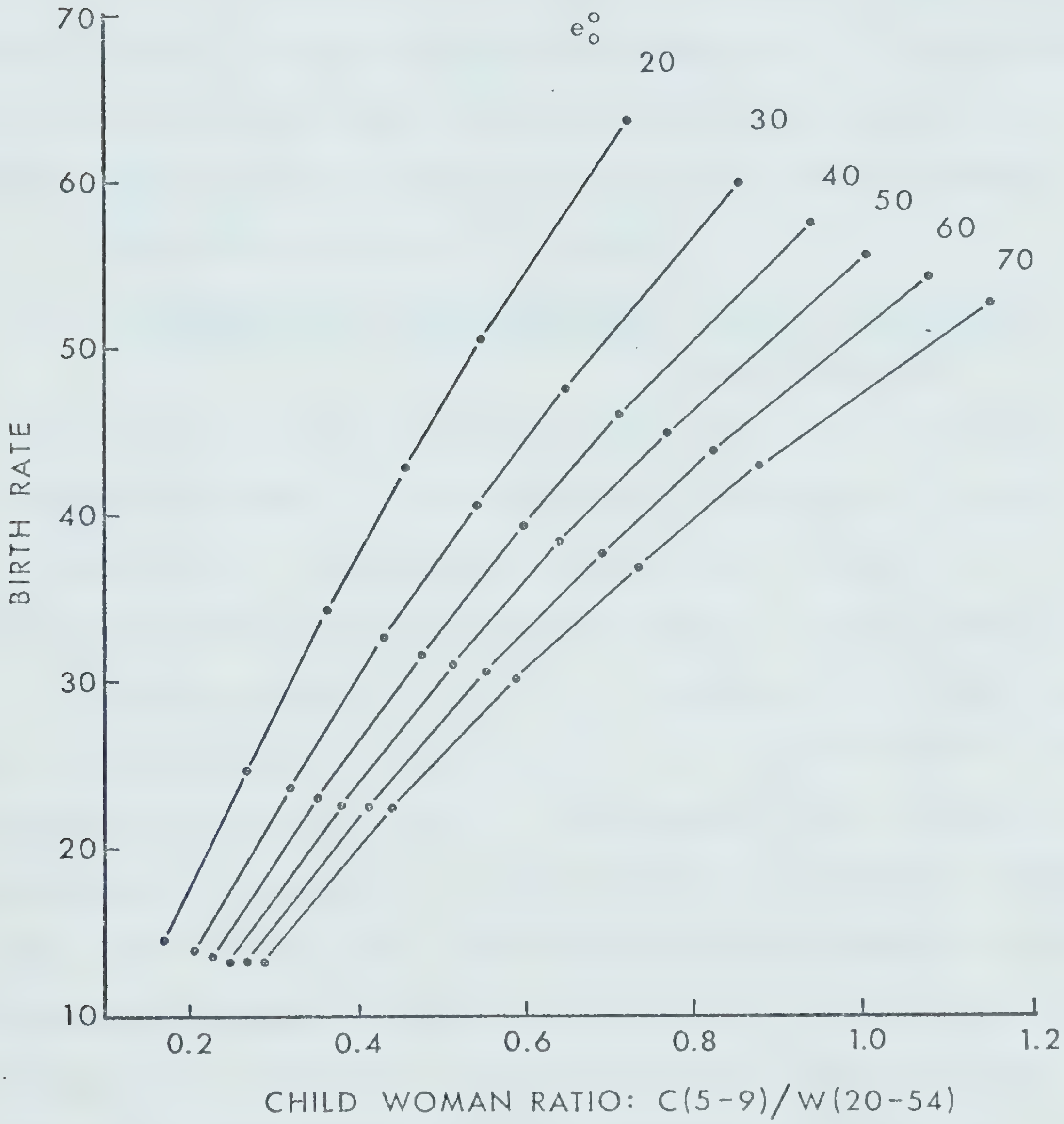
TABLE 6
CHILD-WOMAN RATIOS IN STABLE POPULATIONS BY GROSS REPRODUCTION RATE (GRR) AND EXPECTATION OF LIFE AT BIRTH (e_o^o)

e_o^o	GRR	$\frac{C(0-4)^*}{W(15-44)}$	$\frac{C(0-4)}{W(15-49)}$	$\frac{C(5-9)}{W(20-49)}$	$\frac{C(5-9)}{W(20-54)}$
20	4.0	0.8835	0.8220	0.7699	0.7211
20	3.0	0.6776	0.6206	0.5924	0.5466
20	2.5	0.5713	0.5174	0.5005	0.4570
20	2.0	0.4615	0.4116	0.4052	0.3648
20	1.5	0.3473	0.3029	0.3060	0.2697
20	1.0	0.2299	0.1927	0.2028	0.1728
30	4.0	0.9760	0.9107	0.9111	0.8533
30	3.0	0.7513	0.6903	0.7024	0.6481
30	2.5	0.6349	0.5769	0.5942	0.5424
30	2.0	0.5116	0.4577	0.4794	0.4312
30	1.5	0.3886	0.3402	0.3647	0.3213
30	1.0	0.2590	0.2188	0.2427	0.2074
40	4.0	1.0418	0.9737	1.0014	0.9381
40	3.0	0.8034	0.7394	0.7729	0.7133
40	2.5	0.6796	0.6187	0.6543	0.5974
40	2.0	0.5513	0.4945	0.5310	0.4779
40	1.5	0.4174	0.3662	0.4023	0.3544
40	1.0	0.2781	0.2355	0.2684	0.2284
50	4.0	1.0988	1.0290	1.0732	1.0067
50	3.0	0.8506	0.7848	0.8312	0.7684
50	2.5	0.7186	0.6559	0.7026	0.6426
50	2.0	0.5835	0.5248	0.5706	0.5145
50	1.5	0.4436	0.3906	0.4340	0.3832
50	1.0	0.2963	0.2518	0.2901	0.2474
60	4.0	1.1585	1.0875	1.1460	1.0772
60	3.0	0.8960	0.8289	0.8867	0.8215
60	2.5	0.7595	0.6953	0.7517	0.6893
60	2.0	0.6174	0.5572	0.6113	0.5528
60	1.5	0.4688	0.4143	0.4644	0.4113
60	1.0	0.3147	0.2687	0.3118	0.2670
70	4.0	1.2188	1.1469	1.2189	1.1481
70	3.0	0.9440	0.8758	0.9443	0.8771
70	2.5	0.8009	0.7355	0.8013	0.7369
70	2.0	0.6501	0.5887	0.6506	0.5900
70	1.5	0.4957	0.4398	0.4962	0.4411
70	1.0	0.3334	0.2860	0.3339	0.2871

* $\frac{C(0-4)}{W(15-44)}$ denotes the child-woman ratio obtained by dividing the number of children aged 0 to 4 by women aged 15 to 44. A similar method has been used to obtain the other ratios.

Source: R. J. Rele, Fertility Analysis through Extension of Stable Population Concepts, 1967 : Table 2, p. 16.

FIGURE 2
RELATIONSHIP BETWEEN THE CHILD-WOMAN RATIO AND THE BIRTH RATE BY EXPECTATION OF LIFE AT BIRTH (e_o^o)
FOR STABLE POPULATIONS



Source: J. R. Rele, Fertility Analysis through Extension of Stable Population Concepts, 1967: Figure 8, p. 54.

X is the child-woman ratio and y the birth rate. Table 7 gives the coefficients a, b, c for the child-woman ratios $\frac{C(0-4)}{W(15-49)}$ and $\frac{C(5-9)}{W(20-54)}$.

2.8 Estimation of Crude Birth Rate

The general formula for the Crude Birth Rate = $\frac{B}{P}$ x 1000, where B is the number of total registered live births and P is total population. The crude birth rate is quite useful because it affords the widest possible basis for comparison with data of other populations.

Rele (1967) arrived at the formula:

$$b_c = b_i \cdot \frac{\text{(Weighted sum} \div \text{Total Population) for the given population}}{\text{(Weighted sum} \div \text{Total Population) for the corresponding stable population}}$$

to obtain the relationship between the crude birth rate b_c and the intrinsic birth rate b_i. The weighted sum is defined by 1 · W(15-19) + 7 · W(20-24) + 7 · W(25-29) + 6 · W(30-34) + 4 · W(35-39) + 1 · W(40-44), where W_i refers to the number of women in the age groups (i, i + 4), and the weights 1, 7, 7, 6, 4, 1 correspond to the average pattern of relative age-specific fertility rates. The values used in the denominators are shown in Table 8. The important point to realize is that instead of looking for the actual levels of age-specific fertility rates, their relative levels are sufficient for our estimation purposes. There may be actually two means of arriving at the weighted sums: one could make use of the actual relative age-specific fertility rates (which are rarely available for developing countries) or make use of any other weights which should be close enough to the actual rates in a given situation.

TABLE 7

COEFFICIENTS FOR THE ESTIMATION OF INTRINSIC BIRTH RATE FROM THE CHILD-WOMAN RATIO*

Type of Child-Woman Ratio	Regression Coefficient*	e_o^o					
		20	30	40	50	60	70
$\frac{C(0-4)}{W(15-49)}$	a	-4.96	-5.37	-5.40	-5.45	-5.45	-5.25
	b	106.85	94.21	85.91	79.93	75.02	69.92
	c	-28.21	-24.92	-22.11	-19.96	-18.66	-16.94
$\frac{C(5-9)}{W(20-54)}$	a	-5.38	-5.61	-5.52	-5.52	-5.52	-5.32
	b	121.62	100.57	89.12	81.67	75.78	69.90
	c	-35.57	-28.07	-23.64	-20.75	-19.00	-16.90

* Coefficients of the regression equations $Y = a + bX + cX^2$ computed from stable populations for each e_o^o, where X is the child-woman ratio and Y is the birth rate per 1000 population.

Source: J. R. Rele. Fertility Analysis through Extension of Stable Population Concepts, 1967: Table 13, p. 53.

TABLE 8
THE RATIO OF WEIGHTED SUM OF WOMEN IN THE REPRODUCTIVE AGE GROUPS TO TOTAL POPULATION FOR STABLE POPULATIONS BY GROSS REPRODUCTION RATE (GRR) AND EXPECTATION OF LIFE AT BIRTH (e_o)*

GRR	e_o^o					
	20	30	40	50	60	70
4.0	0.9667	0.9078	0.8758	0.8534	0.8299	0.8088
3.0	1.0255	0.9686	0.9396	0.9163	0.8966	0.8780
2.5	1.0470	0.9919	0.9652	0.9443	0.9270	0.9092
2.0	1.0535	1.0103	0.9782	0.9603	0.9443	0.9304
1.5	1.0338	0.9873	0.9617	0.9423	0.9354	0.9253
1.0	0.9413	0.8906	0.8697	0.8534	0.8449	0.8424

* The weighted sum is defined by 1.W(15-19) + 7.W(20-24) + 7.W(25-29) + 6.W(30-34) + 4.W(35-39) + 1.W(40-44), where W denotes the number of women in the age group given in the parentheses, and the weights 1, 7, 7, 6, 4, 1 correspond to the average pattern of relative age-specific fertility rates.

Source: J. R. Rele. Fertility Analysis through Extension of Stable Population Concepts, 1967: Table 15, p. 58.

The above outlined method was tested by Rele (1967) on countries with available data by comparing the intrinsic and the derived crude birth rates with crude birth rates based on registration characteristics. Countries chosen were limited to the European countries only. Both calculations showed very close results. In fact, the difference between the estimated and the mean registered crude birth rate was not greater than 1.7 per 1000.

CHAPTER III

ESTIMATION OF FERTILITY RATES FOR SELECTED ETHNIC GROUPS IN GUYANA

Due to the unique demographic history of Guyana, we find clusters of various ethnic groups of different sizes. From the brief account of the history of the population in the first chapter, it follows that the various ethnic groups comprising Guyana's population will experience different fertility levels. Estimates of gross reproduction rate, intrinsic birth rate, and crude birth rate for the different ethnic groups will be presented in this chapter. Ethnic groups having small populations (e.g., Syrian, Lebanese) have been ignored for this analysis. The data by age from the 1960 census are essentially the main source for the analysis, enabling us to evaluate child-woman ratios. A note on the quality of the data used for the exercise is also given.

3.1 Quality of Data

One of the major problems in the demographic analysis of the population of an underdeveloped country is the inaccuracy surrounding age statements. This is usually caused by two factors:

1. Deliberate misstatements of age, and
2. Involuntary misstatements (You Poh Seng, 1968: 164).

There is a tendency for a concentration or "heaping" of frequencies at regular intervals; usually, in the ages ending in "0" and "5."

A test for age heaping is possible through the calculation of "age ratios." An "age ratio" is defined as the ratio of the enumerated age group to the average of its two adjoining age groups (Barclay, 1958: 70). If an age is reported correctly, the ratios should approximate unity. An erratic pattern of "age ratios" is a sign of defects located in certain age groups.

Age ratios were computed for Guyana (Table 9). Results for both sexes show fairly erratic fluctuations from what is expected.

To illustrate this unevenness of the population data by age, the age ratios for both sexes in 1960 were plotted against the age ratios based on 1955[1] data (Figure 3). We can clearly see inconsistency between these two curves; for example, in the age groups 35-39 and 45-49, an over-enumeration could have occurred in 1960.

Another method of testing for age statistics is tracing the same cohort of people in two censuses (Table 10). It can be seen that there are more people in the age groups 5-9, 10-14, and 15-19 in 1960 as survivors of the age groups 0-4 and 10-14 in 1955. This can hardly happen since some people had to die during this five-year span. We should caution the reader that we are dealing with United Nations' estimates for 1955 where estimation errors are likely. Furthermore, the United Nations' Demographic Yearbook (1956) excluded Amerindians from the total population but separately estimated them at 19,056.

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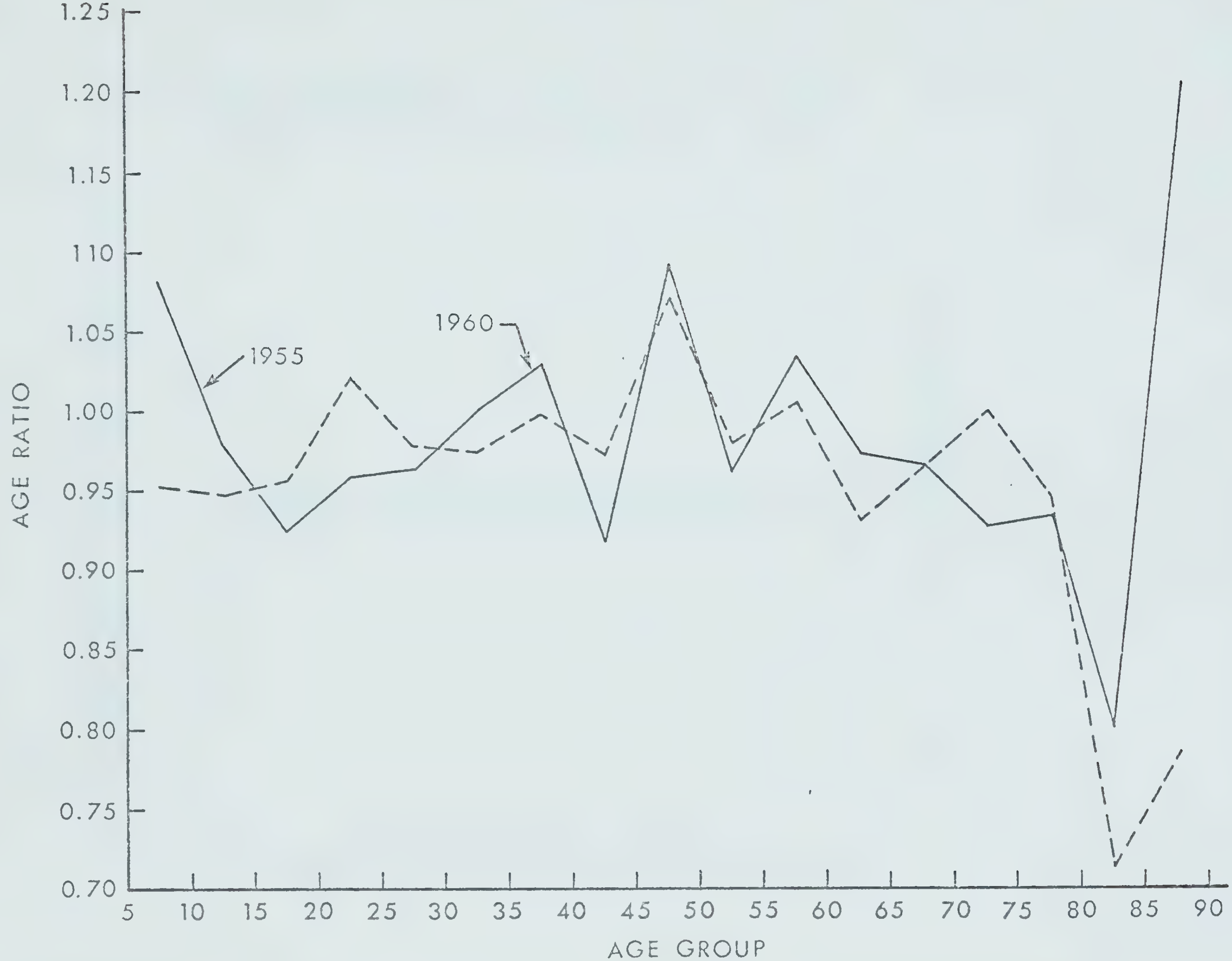
[1]Since the census previous to 1960 was taken in 1947--thirteen years before--the United Nations' estimate for 1955 (United Nations' Demographic Yearbook 1956: 134) was utilized for comparison purposes.

TABLE 9
AGE RATIOS FOR BOTH SEXES IN GUYANA,
1955 and 1960

Age Group	1955	1960
5-9	0.9512	1.0809
10-14	0.9481	0.9816
15-19	0.9563	0.9244
20-24	1.0222	0.9598
25-29	0.9777	0.9639
30-34	0.9738	0.9993
35-39	0.9985	1.0317
40-44	0.9723	0.9181
45-49	1.0705	1.0901
50-54	0.9815	0.9514
55-59	1.0060	1.0344
60-64	0.9303	0.9734
65-69	0.9657	0.9660
70-74	1.0005	0.9274
75-79	0.9455	0.9304
80-84	0.7134	0.8032
85-89	0.7863	1.2041

Source: Computed from the 1960 Census of British Guiana and United Nations' Demographic Yearbook 1956.

FIGURE 3
PLOT OF AGE RATIOS FOR BOTH SEXES IN GUYANA, 1955 AND 1960



Source: Table 9.

TABLE 10

AGE DISTRIBUTION FOR BOTH SEXES IN GUYANA, 1955 and 1960

Age Group	1955	1960
0	18810	21636
1-4	66215	76541
0-4	85025	98177
5-9	64670	90948
10-14	50955	70103
15-19	42820	51884
20-24	38595	42157
25-29	32690	35959
30-34	28275	32458
35-39	25380	29003
40-44	22560	23767
45-49	21025	22774
50-54	16720	18015
55-59	13045	15098
60-64	9215	11177
65-69	6765	7867
70-74	4795	5111
75-79	2820	3155
80-84	1170	1671
85-89	460	1006

Source: Computed from Census 1960 for British Guiana and United Nations, Demographic Yearbook 1956.

Consequently, we have to assume that the above inconsistencies occurred most likely from age "heaping."

3.2 Estimates for Guyana

The choice of ethnic groups was as follows: Amerindians, East Indians, Chinese, Negros, Mixed, and Portuguese. In the 1960 census, however, "Whites" were classified as a distinctive group but no estimates are provided for this group in view of its small size.

In estimating fertility measures for Guyana, only two types of child-woman ratios were used: $\frac{C(0-4)}{W(15-49)}$ and $\frac{C(5-9)}{W(20-54)}$. These were chosen because Rele (1967) was able to arrive at better estimates of gross reproduction rates with the help of these two indirect measures.

According to Demographic Yearbook, 1970, the expectation of life at birth in Guyana for the years 1959-1961 for males was 59 years and for females 63 years; the average expectation of life at birth for both sexes was 61. Thus $e_o^o = 60$ was adopted. For the purpose of comparison and also to show the relative insensitivity of different mortality levels on the fertility index, the level of $e_o^o = 50$ was also chosen.

One more caution regarding the choice of e_o^o: as correctly pointed out by Rele, we should chose e_o^o which would refer to some period more than 5 years before census. The reason is that our child-woman ratio is based on the children surviving during the 5 years before census when the effect of mortality improvements on young ages are most pronounced. Taking e_o^o at the time of census would tend to over-estimate the fertility index. The e_o^o in 1950-1952 was 53.2 for males and 56.3 for females, the average for both sexes being 54.7.

We can therefore see quite an improvement in mortality in 1960, most of which presumably occurred during the 5 years preceding the census in 1960. Consequently, the choice of e_0^o of 60 will tend to over-estimate and $e_0^o = 50$ to under-estimate the actual fertility. However, as already mentioned, if we take the value of e_0^o as the nearest multiple of ten, we will introduce only a small error in our fertility index. Therefore, when using values of $e_0^o = 50$ and 60 for estimation purposes, we should obtain fairly close results.

Estimates of fertility rates for the major ethnic groups in Guyana obtained by Bogue-Palmore method are presented in Table 11. The "Mixed" group has an extremely high crude birth rate of 53.7. Next to the "Mixed" group are the East Indians with a crude birth rate of 48.1 and Amerindians with a crude birth rate of 44.6. The Chinese and the Negros show considerably lower fertility as compared to the first three groups. The crude birth rates for these groups are 20.1 and 35.4, respectively. The crude birth rate for Guyana as a whole is 43.3.

By Rele's method, gross reproduction and crude birth rates were obtained and are presented in Table 12. The gross reproduction rate$_1$[2] is highest for the "Mixed" group (3.7), followed by East Indians (3.3),

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[2]GRR_1 is GRR with $e_0^o = 60$ and child-woman ratio $\frac{C(0-4)}{W(15-49)}$

GRR_2 is GRR with $e_0^o = 50$ and child-woman ratio $\frac{C(0-4)}{W(15-49)}$

GRR_3 is GRR with $e_0^o = 60$ and child-woman ratio $\frac{C(5-9)}{W(20-54)}$

GRR_4 is GRR with $e_0^o = 50$ and child-woman ratio $\frac{C(5-9)}{W(20-54)}$

TABLE 11

FERTILITY ESTIMATES FOR GUYANA -- BOGUE AND PALMORE'S METHOD

	Guyana	East Indian	Negro	Mixed	Chinese	Amerindian	Portugese
CBR	43.3	48.1	35.4	53.7	20.1	44.6	21.9
TFR	6.198	6.890	5.044	7.707	2.826	6.391	3.081
GFR	192	219	153	240	78	198	84
ASFR							
15-19	117	133	90	153	37	122	43
20-24	312	343	260	380	160	321	172
25-29	320	351	269	387	170	329	182
30-34	243	271	199	303	113	251	123
35-39	168	191	131	217	59	174	68
40-44	65	75	51	85	22	68	26
45-49	12	14	9	16	3	13	3

Source: Estimates from Census Data.

TABLE 12

FERTILITY ESTIMATES FOR GUYANA--RELE'S METHOD

	Guyana	East Indian	Negro	Mixed	Chinese	Amerindian	Portuguese
GRR_1	3.0	3.3	2.4	3.7	1.4	3.1	1.5
GRR_2	3.1	3.5	2.6	3.9	1.5	3.2	1.6
GRR_3	3.3	3.9	2.5	3.8	1.8	3.2	1.7
GRR_4	3.5	4.2	2.6	4.1	1.9	3.4	1.9
CBR_1	42.	43.7	34.7	49.4	17.9	43.6	20.1
CBR_2	43.1	45.8	36.4	51.5	19.2	45.7	17.3
CBR_3	44.3	51.7	35.4	50.8	23.9	44.9	23.7
CBR_4	47.	56.5	37.7	53.4	25.4	47.5	25.2

Source: Estimates from Census Data.

Amerindians (3.1), etc.. The results of gross reproduction $rate_2$ show the same ordering of ethnic groups as in the previous case. However, all values of gross reproduction $rate_2$ are slightly higher than those of gross reproduction $rate_1$. Gross reproduction $rate_3$ order the ethnic groups differently. The highest value of gross reproduction $rate_3$ was observed for the East Indians (3.9) followed by "Mixed" (3.8), Amerindians (3.2) and Negros (2.5). We get the same ordering of ethnic groups with gross reproduction $rate_4$. The gross reproduction $rate_4$ shows again higher values than those of gross reproduction $rate_3$. A similar change has occurred with crude birth $rate_3$ and crude birth $rate_4$ as with gross reproduction--the East Indians have higher crude birth rate in these two categories than "Mixed" group. In all cases, the fertility measures for the Portuguese have the lowest values among the selected ethnic groups. It is, however, not possible to compare these fertility measures with those obtained by direct method (i.e., derived from registration systems and census data) due to non-availability of adequate data. Even though there were estimates prepared for some Latin American countries by Cho (1965) and Collver (1965), Guyana was not included in the list of these countries.

Since the estimates in this exercise were derived from two independent procedures, we can compare them for consistency. The crude birth rates obtained by both these methods are fairly close. This lends support to the fact that the ethnic-specific fertility rates are satisfactorily estimated.

CHAPTER IV

DIFFERENTIAL FERTILITY

Many questions appear when a researcher starts looking at fertility differentials in a population. Is the differential due to the fact that certain segments of the population are not able or not willing to bear children? Are psychological factors of motive and preference for children, or biological factors, more central to an explanation of the differences? Unfortunately, both factors are always present in determining fertility differences. In some instances, biological factors have been culturally influenced.

In answering the above questions, discussion will be centered on the following:

1. Biological Factors
2. Sociological Factors
3. Davis-Blake Framework

4.1 Biological Factors

All biological factors affecting fertility operate through fecundity (the physiological ability to reproduce). Fecundity is a function of several factors such as age, health, heredity, interpregnancy interval, and coital incidence. Some of them are discussed below.

a. Age. The capacity of a woman to reproduce is limited to a certain age span of her life. This period can vary in length from 31 to 33 years. According to biologists, a female can theoretically give birth to 20-22 children during the childbearing period (Thompson, 1953: 172). The fact that in real life this does not happen indicates that other factors must play an important role in determining fertility.

b. Health. To experience the highest possible fecundity, a woman must be in a state of good health. The reproductive system is directly affected by gonorrhea and syphillis leading to fertility impairments. Nutritional deficiency, psychic stress, etc., also affect directly or indirectly the reproductive capacity.

4.2 Social Factors

Social factors such as a society's institutions, laws, values, policies, income, education, or value placed on marriage and children influence fertility and operate differently in different situations.

a. Occupation. Analysis of fertility by occupational groups tended to show that the average number of children per couple was inversely related to the occupational status of the husband. Kiser, *et al*. (1968) noticed that in certain population groups in the United States the occupational differential was reducing over time.

b. Income. In the case of income, the inverse relation is not very explicit. Even though this relationship is generally inverse, consideration of the Kiser, *et al*. study (1968) for the United States requires us to modify this view. Controlling for age, it was seen that the relation was direct at ages under 25, absent for age group 25-29,

and inverse at ages 30 and over. An explanation for this phenomenon is that young people of high income are more likely than people of low income to confine their childbearing to a relatively short period after marriage and are more receptive to contraception.

c. Education. Fertility varies inversely with respect to education. The number of children born per married woman who had completed childbearing varied between 1.4 for college graduates and 3.0 among those with only elementary education. There is again a tendency for a narrowing of this differential (Thomlinson, 1965: 181).

4.3 Davis-Blake Framework

Davis and Blake (1956) classified the social variables that affect fertility, either by interfering with, or by facilitating the completion of, the different stages of the reproductive process. They were able to group the social variables under three main headings: factors affecting exposure to intercourse, conception, and gestation and parturition. Their model was the first which focused upon the relationship between institutional mechanisms in a society and "intermediate variables." Davis and Blake (1956: 211) presented their model schematically as follows:

- I. Factors Affecting Exposure to Intercourse ("Intercourse Variables").
  - A. Those governing the formation and dissolution of unions in the reproductive period.
    - 1. Age of entry into sexual unions.
    - 2. Permanent celibacy: proportion of women never entering sexual unions.
    - 3. Amount of reproductive period spent after or between unions.
      - a. When unions are broken by divorce, separation, or desertion.
      - b. When unions are broken by death of husband.

B. Those governing the exposure to intercourse within unions.
   4. Voluntary abstinence.
   5. Involuntary abstinence (from impotence, illness, unavoidable but temporary separations).
   6. Coital frequency (excluding period of abstinence).

II. Factors Affecting Exposure to Conception ("Conception Variables").
   7. Fecundity or infecundity, as affected by involuntary causes.
   8. Use or non-use of contraception.
      a. By mechanical and chemical means.
      b. By other means.
   9. Fecundity or infecundity, as affected by voluntary causes (sterilization, subincision, medical treatment, etc.).

III. Factors Affecting Gestation and Successful Parturition ("Gestation Variables").
   10. Foetal mortality from involuntary causes.
   11. Foetal mortality from voluntary causes.

In the absence of these limiting or facilitating "intermediate variables," we could assume that women are capable of bearing the number of children close to their maximum reproductive capacity. It is these social factors behind the biological ones that are responsible for the differences in fertility within a society and between societies.

4.4 Development of Research Hypotheses

Most of the childbearing occurs within marriage. Therefore, the number (or proportion) of cohabiting fertile females and the type of union are important from a fertility perspective. Braithwaite and Roberts (1963) studied mating patterns among the Negro population of Trinidad. The distribution of mated women in Trinidad, as revealed in their data, is given in Table 13.

The chance of being exposed to intercourse is highest for women in the last category, that is, in "married union," and lowest for women

TABLE 13

DISTRIBUTION OF MATED WOMEN BY UNION STATUS, TRINIDAD

Union Status	Per Cent
Not in union	30.3
In visiting union	21.2
In common law union	21.1
In married union	27.4

Source: L. Braithwaite and G.W. Roberts, "Mating Patterns and Prospects in Trinidad." Proceedings of the International Population Conference, New York 1961; p. 175.

in the "visiting" category, because of the intermittent nature of the sexual contact of the participants. Correspondingly, Roberts and Braithwaite found that the visiting type of union produces fewer children as compared to married unions.

Populations of South and Central America are characterized by a high incidence of consensual unions. Mortara (Bogue, 1969: 328), in his study of Latin American countries showed that in five of them (e.g., Guatemala, Haiti) the number of persons living in consensual unions was larger than the number living in normal marriages. In eight others, there were at least 50 consensual unions per 100 regular marriages (e.g., Cuba, Peru).

Consensual unions are usually unstable and hence can influence the fertility level of population. Blake (1961) and Stycos (1968) find evidence to support their contention that unstable unions depress fertility. They found that married women who were close to the end of their childbearing period had 70 per cent more pregnancies than women in visiting relations, and close to 50 per cent more than women living in common law.

Another important factor to be considered is the proportion ever marrying. Each population group seems to have its own unique pattern of marriage. Hajnal (1953) assembled data for proportions of single at certain ages for several countries in Europe and in the United States and found that countries of North-Western Europe experienced "a marriage boom" during the period 1935-1950 and that this partially caused the so-called "baby boom" of 1946-1950. His data indicate that during the period proportions of single women or men were

relatively smaller than in previous years. For fertility studies the proportion of women is an important demographic parameter because unmarried women have the lowest chance of being exposed to the risk of childbearing. The occurrence of this phenomenon varies greatly among the various socio-economic or cultural groups.

4.5 Hypotheses

On the basis of the previous research discussed above, we see that a number of factors are involved in understanding the fertility patterns of the different groups which constitute a nation. From this range of factors three have been selected for explaining the fertility differential in Guyana.

The hypotheses are:

H1. If a female population in a group is characterized by a larger incidence of unstable unions then that group will have lower fertility than one which is not so characterized.

H2. If the proportion of single women in reproductive ages in a population segment is large then that segment will have lower fertility.

H3. If a population group has a higher proportion of females with a certain level of education then that population group will experience lower fertility than one with a lower level of education.

4.6 Negro-East Indian Fertility Differential

The multiple regression analysis is employed to test these hypotheses. The method essentially involves establishing the relationship between some fertility index (child-woman ratio) as dependent variable and proportions of unstable unions, single women, females with

a certain level of secondary schooling as independent variables.

Those administrative districts each of which had at least 40 per cent of a particular ethnic group have been chosen as units of analysis. Operationalization of the dependent and the independent variables was done as follows. The child-woman ratio $\frac{C(0-4)}{W(15-49)}$ was calculated for each enumeration district. The proportion of common law unions in a district was computed as the ratio of women in the age group (15-44) who live in common union to the female population in the age bracket (15-49) years. Similarly, the proportion of single women in a district was obtained as the ratio of single women (15-44) to the female population aged 15-49. The education variable was operationalized as the ratio of females aged 15 and over having secondary school certificates to the total female population aged 15+.

Negros and East Indians only were involved in this analysis. These two groups comprise about 80 per cent of the total population of Guyana. Consequently, there was no district with a significant number of population with other ethnic background. Thus, the analysis had to be confined to these two groups.

The analysis encountered the problem of sample size. For both East Indians and Negros, the number of data points is five. Dealing with only a limited number of observations (because of necessity) as in this case, a certain unreliability is introduced into the statistics.

4.7 Regression Analysis

When a dependent variable is influenced by two or more independent variables, we can represent this relationship by means of

a multiple regression equation:

$$X_1 = a + b_2X_2 + b_3X_3 + \ldots b_nX_n$$

where X_1 is dependent and $X_2 \ldots X_n$ are independent variables (Ezekiel and Fox, 1959: 152). The multiple linear regression equations were computed in a stepwise manner with the help of BMD program (Dixon, 1968). At each step one independent variable is added to the regression equation. The first independent variable added is that one which shows the highest partial correlation with the dependent variable partialled on the variables which have already been added this way; it also makes the greatest reduction in the error sum of squares.

However, it sometimes happens that, in a regression model, independent variables are highly correlated (Boudon, 1968: 220) and this is so in our case. This can be easily seen from the correlation matrix (see Table 14). The inter-correlations of the independent variables are very high and, therefore, it is difficult to evaluate fully their separate effects on the dependent variable.

For the Negro group, 91.3 per cent of the variation in the dependent variable is accounted for by the independent variable X_3, that is, by the proportion of single females. The correlation of X_1 with X_3 is negative as expected. In view of the high inter-correlation between X_2 and X_3, and X_2 and X_4, the proportion of the varience in X_1 explained by X_3 and X_4 is not high when they were added.

In the case of the East Indian group (Table 15), the problem of multicollinearity was considerably less evident in comparison with the Negro group. However, the highest correlation was not between X_1 and X_3

TABLE 14
CORRELATION MATRIX AND MULTIPLE REGRESSION
COEFFICIENTS -- NEGRO

Correlation Matrix

Variable Number	X_1	X_2	X_3	X_4
1	1.000	0.912	-0.913	-0.754
2		1.000	-0.852	-0.921
3			1.000	0.628
4				1.000

Multiple Regression Coefficient

Step Number	Variable Entered	R	RSQ	Increase in RSQ
1	3	0.9129	0.8334	0.8334
2	2	0.9483	0.8994	0.0660
3	4	0.9491	0.9007	0.0013

Legend: X_1 = child-woman ratio

X_2 = proportion of women aged 15-49 who are in common law union

X_3 = proportion of women in 15-49 age group who are single

X_4 = proportion of women aged 15 and above who have secondary education.

Source: Regression Analysis

TABLE 15

CORRELATION MATRIX AND MULTIPLE REGRESSION COEFFICIENTS -- EAST INDIAN

Correlation Matrix

Variable Number	X_1	X_2	X_3	X_4
1	1.000	0.882	-0.549	-0.545
2		1.000	-0.101	-0.395
3			1.000	0.380
4				1.000

Multiple Regression Coefficient

Step Number	Variable Entered	R	RSQ	Increase in RSQ
1	2	0.8824	0.7787	0.778
2	3	0.9962	0.9924	0.213
3	4	0.9972	0.9944	0.002

Legend: X_1 = child-woman ratio

X_2 = proportion of women aged 15-49 who are in common law union

X_3 = proportion of women in 15-49 age group who are single

X_4 = proportion of women aged 15 and above who have secondary education.

Source: Regression Analysis

as in the previous case, but between X_1 and X_2 (proportion of common law unions). This positive correlation between X_1 and X_2 in both cases is not in the expected direction. The increase in RSQ has been considerably more between the first and second step of the analysis than in the previous case. And, 21.4 per cent of the variance in X_1 was explained by X_3 (the proportion single).

In any case, the analysis confirms hypotheses H_2 and H_3. Unfortunately, hypothesis H_1 is not confirmed. With a small number of data points at hand, it is difficult to press this further. The analysis is further supported by looking at the data in Table 16. It will be noticed that the East Indians, who have higher fertility than the Negro group, have a lower proportion of single women. The ratio of educated women is also lower for the East Indian woman as compared to the Negro woman. There is clearly one more conclusion. It follows from the above that the East Indian group must have consequently a higher proportion of ever married women which significantly influences its fertility level.

4.8 Role of Age Composition in Negro-East Indian Fertility Differential

The difference in fertility between various groups may be due to difference, among other things, in age composition. To control for differences in age composition, the direct standardization method was used. The rate of childbearing varies markedly with age. If two populations differ significantly in the age composition of females, it is clear that the population with the greater proportion of females in the childbearing span, *ceteris paribus*, would tend to have a higher fertility rate. Standardization permits comparisons since it helps in keeping constant

TABLE 16
DISTRIBUTION OF VALUES OF X_1, X_2, X_3, X_4 IN EACH
DISTRICT FOR EAST INDIAN AND NEGRO GROUPS

Case Number	X_1	X_2	X_3	X_4
East Indian				
1	0.8970	0.0890	0.0370	0.0180
2	0.9140	0.1020	0.0390	0.0130
3	0.8830	0.0650	0.0340	0.0150
4	0.9150	0.0700	0.0240	0.0140
5	1.0060	0.1340	0.0260	0.0130
Negro				
1	0.5220	0.0600	0.0100	0.0680
2	0.7430	0.0540	0.1120	0.0420
3	0.5970	0.0610	0.1020	0.0310
4	0.8450	0.0310	0.1790	0.0320
5	0.8470	0.0340	0.2510	0.0170

Legend: X_1 = child-woman ratio

X_2 = proportion of women aged 15-49 who are in common law union

X_3 = proportion of women in 15-49 age group who are single

X_4 = proportion of women aged 15 and above who have secondary education.

Source: Computed from 1960 Census of British Guiana.

the hidden effect of population structure.

As a standard population, the "Mixed" group was chosen. Age standardized (general) fertility rate for the East Indians was 214.3, while the general fertility rates of the East Indian and "Mixed" ethnic groups were 218.5 and 239.5. This shows that if the East Indian group had an age composition of the standard population, it would have its fertility lowered by 4.2 points. We can, therefore, say that the East Indian age composition is more conducive to higher fertility than that of the standard population (Mixed group) which experiences the highest fertility in Guyana (Table 17). The Negro standardized fertility rate was 157.1 and non-standardized was 152.7, revealing that the Negros would have a fertility rate increased by 4.4 points if they had the age structure of the standard population. Standardized rates reveal that the Amerindian fertility does not change much, leading to the conclusion that its age structure is similar to that of the Mixed group.

If the whole country had the age composition of the "Mixed" group, it would experience an increase in fertility by 1.8 points. It is, therefore, possible to say that Guyana on the whole has a very favorable age composition, conducive to overall high fertility.

These findings are further strengthened if we look at the percentage of women in their most reproductive ages, that is, between ages 20 and 34 in relation to the total female population comprising the ethnic groups under consideration. The distribution is as follows:

TABLE 17

AGE STANDARDIZED FERTILITY RATE

	Guyana	East Indian	Negro	Mixed	Chinese	Amerindian	Portugese
AGFR	194.1	214.3	157.1	(239.5)	88.4	198.7	96.2

Source: Computed from estimated rates.

East Indian . . . . . 48.3 %

Mixed . . . . 46.8 %

Negro . . . . 45.8 %

Chinese . . . . 42.5 %

Guyanese. . . . . . . 46.9 %

This confirms the earlier finding that the age composition of the East Indians is more favorable for a high fertility performance than the "Mixed." Guyana, taken as a whole, surprisingly enough, has a composition more conducive to high levels of fertility than the "Mixed" group. This confirms the fact that the age composition of Guyana is favorable for high fertility.

CHAPTER V

SUMMARY AND SUGGESTIONS FOR FUTURE RESEARCH

This study of fertility differentials in Guyana was undertaken with the intention of filling the gap in our knowledge of the demographic situation of that country.

An attempt was made to estimate basic direct fertility measures from indirect ones, with the help of two independent methods. Employing the Bogue-Palmore method, the crude birth rate, the age-specific fertility rates, the general fertility rate, and the total fertility rate were calculated. Rele's method yielded estimates of gross reproduction rate and the crude birth rate.

Both methods showed that the "Mixed" group has the highest fertility in Guyana, followed by the East Indian, Amerindian, Negro, Chinese, and Portuguese groups, in that order.

In order to explain differentials in fertility between Negros and the East Indians, three hypotheses were put forward:

1. If a female population in a group is characterized by a larger incidence of unstable unions then that group will have lower fertility than one which is not so characterized.

2. If the proportion of single women in reproductive ages in a population segment is large then that segment will have lower fertility.

3. If a population group has a higher proportion of females with a certain level of education, then that population group will experience lower fertility than one with a lower level of education.

Multiple regression analysis was employed for testing these hypotheses. The problem of multicollinearity, however, was encountered. This was particularly obvious in the case of the Negro group. The problem of multicollinearity was considerably less evident in the East Indian group. The analysis confirmed two of the three hypotheses.

It has been demonstrated that the age composition of a population has a considerable influence on its fertility performance. In order to study the fertility performance of the various groups in Guyana, the "Mixed" group was chosen as the standard population. Though this group is the most fertile in Guyana, results show that if the East Indians had the age compostion of the "Mixed" group, they would actually experience lower fertility than they do now. It also appears that if the remaining ethnic groups had the age compostion of the standard population, their fertility would increase.

The above results are consistent with the data on proportion of women in their most reproductive ages. The proportion is highest for the East Indian group, followed by the "Mixed" and the Negro groups.

5.1 Suggestions for Further Research

Certainly there are areas of this study which could be further explored. One direction for future work is to consider fertility in relation to other demographic and socio-economic variables. The Davis-Blake model can be exploited to provide demographically meaningful results.

The differential frequency of coitus in different groups, *ceteris paribus*, tends to result in fertility differentials. Another important factor to be considered is the differential use of contraception. Together with the age at first marriage and the proportion marrying, which determines the number of woman-years at risk in a population, availability of birth control facility, etc., a more meaningful study of differential fertility can be carried out. The influences of religion, place of residence, and social mobility expectations also need to be probed into for a comprehensive analysis of fertility differentials. Such a detailed study will be rendered possible only if data on complete reproductive history, marriage, and family planning practices are gleaned on a national representative sample of men and women in Guyana.

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